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A COMPARATIVE STUDY OF SENSORY TRAINING VERSUS DUAL TASK TRAINING FOR IMPROVING BALANCE IN ELDERLY

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Abstract

Aim and objective

1. Aim to determine which technique among sensory integration training and dual task training is more effective in improving balance and reducing fear of fall.
2. Objective
To compare the effectiveness of sensory integration training and dual task training in improving balance and reducing fear of fall in elderly.

Methods:

A total of 30 community-dwelling elderly participants between the age of 60 to 75 years were selected using purposive sampling and randomized into two groups (15 in each group). Pre and post test was conducted by Berg balance scale and Fall efficacy scale.

Results:

Group A (sensory integration training) showed greater improvements in balance as indicated by higher post-intervention BBS scores, whereas Group B (dual-task training) showed more improvement in fall efficacy scores.

Conclusion :

This study concluded that, there is no significant difference between the both approaches therefore it is difficult to state that which intervention is better.



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Introduction

Ageing is an inevitable biological process that accompanied with various physiological changes that significantly affects an individual physical, and functional capabilities. According to world health organization ageing is characterized by accumulation of wide variety of molecular and cellular damage over time , leading to gradual decrease in physical and mental capacity increase the risk of heart disease .

Age related neurophysiological changes in multisensory integration , including vision ,proprioception and vestibular functions can impact an individual ability to maintain balance age related decline impaired the sensory functioning that impacts the quality of life of elderly by influencing the way they experience the environment and react to stimuli and limiting social activities. Impaired sensory system also has negative consequences for somatic health. For example, vision loss increases the risk of falls and fractures, olfactory loss complicates the detection of dangers in the environment (6).Balance is a complex motor skills requiring the integration of sensory and motor function. Balance is an ability to control and maintain posture (1),

However our ability to maintain balance decline as our age progress that results as a major risk of falls among elder population. According to World Health Organization falls are the second most common cause of unintentional injuries worldwide, posing a significant public health concern. (2).Falls represent a significant global public health issue, with approximately 684,000 fatalities annually, Falls are the known problem, with the study indicating that one in three individual age 65 and older will experience fall. Furthermore 50 % of these individual will suffer from future falls. Several studies have determined the physical consequences of falls. Such as hip fractures (1%) fractures of other site(3%)or brain injuries (2%), the incidence of falls is higher in women than in men and it rise with the advancing of age. Poor balance is initially detectable in early stage of the life(14)(15)(16).

Methodology

Study design

- Experimental study

Method of study

- Qualitative study

Study mode

- Comparative study

Type of sampling

- Purposive sampling

Sampling sources

- Community dwelling

Sample size

- 30 (15 in each group)



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Duration of study

- Six months

Criteria

Inclusion criteria

- Age between 60- 75 years.(2)
- Both male and female.
- Individual who ambulate without any assistance.
- Those who have experienced fall in last 6 months.
- MOCA score(>26).
- Those who can understand simple instructions.

Exclusion criteria

- Person affected with verbal communication.
- Person affected with any symptomatic orthopedic and cardiac condition.
- Person with orthosis.
- Person with uncorrected with visual and auditory impairments.
- Those who have not participated in any other programs for improving balance in last 6 months.
- Person diagnosed with severe neurological and psychological disorders.

Variables

Dependent variables

Independent variables

Baseline concern

Berg balance scale

Fall efficacy scale

Procedure

Written ethical permission for the study was obtained from the Institutional Ethics Committee of the Indian Spinal Injuries Centre prior to commencement. A thorough explanation of the study procedure was given to the participants and caregivers and a duly sign consent form was obtained from the participants. A total of 30 community-dwelling older adults were recruited and randomly allocated into two groups, with 15 participants in each group. For inclusion, participants were screened using the Montreal Cognitive Assessment (MoCA) to rule out significant cognitive impairment and the Timed Up and Go Test (TUG) to ensure they were community ambulators. Eligible participants then underwent baseline assessment using the Berg Balance Scale (BBS) to evaluate balance and the Falls Efficacy Scale (FES) to measure fear of falling. Group A received 30-minute sessions of Sensory Integration Training, which involved exercises targeting the visual, vestibular, and somatosensory systems such as standing on unstable surfaces and performing activities with reduced visual input. Group B received 45-minute sessions of Dual Task Training, consisting of balance activities combined with cognitive or motor tasks such as walking while counting backwards, carrying objects, or performing verbal tasks while maintaining posture. After the intervention period, post-test assessments were conducted using the same outcome



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measures (BBS and FES), and the pre- and post-intervention scores were compared within and between groups to determine the relative effectiveness of the two training protocols.

Data Analysis and Result

Data Analysis: The data analysis was done by using statistical package for social science (SPSS)for window , version 29.0.

Demographics characteristics of the participants such as number of individuals, age, gender were summarized using descriptive statistics. To access the distribution of data, Normality testing was performed using Shapiro - wilk tests , the results indicated that the data is normally distributed ,in Group A (Sensory integration training) suggesting a normal distribution of data. as For within-group comparisons (before and after the intervention in each group), paired – t test were used. For group B dual task training the data was skewed so non parametric test were applied. For between the groups comparisons (before and after the intervention in each group), Mann- whitney U test were applied, The statistical significance was set at $p < 0.05$

Descriptive statistic

Table: 1 presents the demographic data of participants in both the group Sensory integration training (Group- A) and Dual task training (Group-B). Each group consisted of 15 participants, males and females (9 males and 6 females) in group –A ; (3 males and 12 females) in Group –B.The age range for both groups was 60-75 years the mean age of participants in Group A was 69.87 years and $SD = \pm 5.475$, while the mean age of group B was 69.07 years and $SD = \pm 5.457$.

S.NO	BASELINE CHARACTERISTICS	GROUP A EXPERIMENTAL GROUP	GROUP B CONTROL GROUP
1	No of participants	15	15
2	Age range (years)	60-75	60-75
3	Mean age (SD)	69.87±5.475	69.07±5.457
4	Sex MALE FEMALE	9:6	3:12

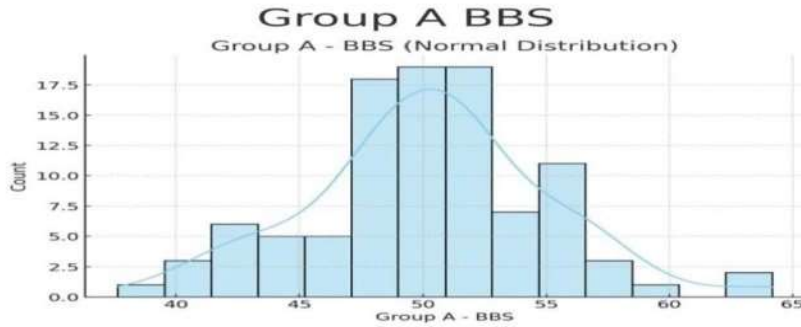
Table: 1

Table 2: Test of Normality in Group A (Sensory integration training)

The table number 2 presents the result of sensory integration training group from the well known test i.e, Shiparo –wilk test. The significant value of BBS ,and FES is greater than ($p > 0.05$), suggesting that these variables are normally distributed.

Group -A	Shiparo - Wilk		
	statistic	DF	sig
BBS	.957	15	.645
FES	.951	15	.534

Graph 5.2: BBS illustrates a bell shaped curve, indicating a normal distribution of data.



Graph 5.3: FES illustrates a bell shaped curve, indicating a normal distribution of data.

In group –A (SIT).

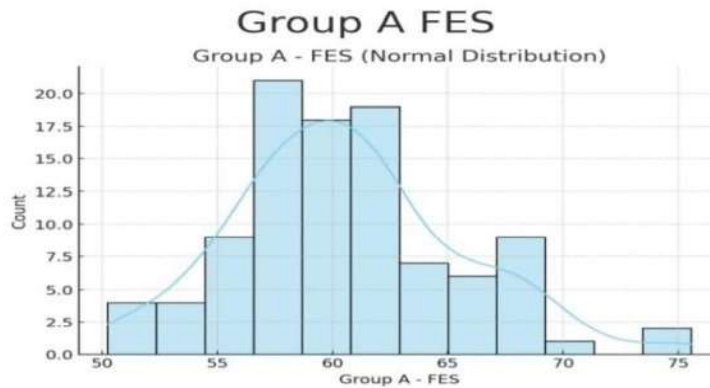


Table 3: Test of Normality in Group- B (Dual task training).

The table number 3 present the result of Dual task training group from a well known test of normality , i.e Shiparo- wilk test the significance value of BBS is less than 0.05) , suggesting that the data is deviated from the normality exhibit a skewed distribution



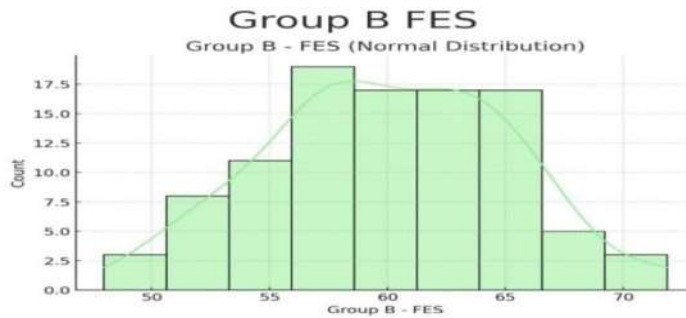
Group -B	Shiparo - Wilk		
	statistic	DF	sig
BBS	.782	15	.002
FES	.924	15	.224

Table no: 3



Graph 5.4

Graph 5.4: BBS illustrates a right –skewed distribution , indicating the data is not normally distributed in group –B (DTT)



Graph 5.5

Graph 5.5: FES illustrates a bell shaped curve, indicating a normal distribution of data. In group –B (DTT).

Pre and post data analysis of Berg balance scale within the Group A.

(Sensory integration training).



The paired-t test was applied for the pre and post data analysis. Analysis of data showed a significant difference between the pre and post-test of Berg balance scale in group A with p value 0.047 , t value = - 5.018 .refer to table number :4.

Test	Mean ± SD	T value	Significance (p value<0.05)
BBS Pre Test	37.00 ± 5.318	-5.018	0.04
BBS Post Test	43.07 ± 3.900		

Table no: 4

Pre and post data analysis of Fall efficacy scale within the Group A.

(Sensory integration training).

The paired –t test was applied for the pre and post data analysis. Analysis of data showed a no significant difference between the pre and post-test of fall efficacy scale in group A with p value 0.64 , t value = 4.701. refer to table number : 5.

Test	Mean ± SD	T value	Significance (p value<0.05)
FES Pre Test	54.73 ±8.276	4.701	0.64
FES Post Test	42.40 ± 11.198		

Table no: 5

Pre and post data analysis of Berg balance scale within the Group B (Dual task training) .

The Wilcoxon signed rank test was applied for the pre and post data analysis. Analysis of data showed a no significant difference between the pre and post-test of berg balance scale in group B with p value = 0.60, z value = -1.884 . refer to table number :6.

Test	Mean ± SD	z value	Significance (p value<0.05)
BBS Pre Test	43.00 ± 10.107	- 1.884	0.60
BBS Post Test	46.27 ± 3.634		

Table no :6



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Pre and post data analysis of Fall efficacy scale within the Group B (Dual task training).

The Wilcoxon signed rank test was applied for the pre and post data analysis. Analysis of data showed a significant difference between the pre and post-test of fall efficacy scale in group B with with p value 0.001, z value = -3.06 .refer to table number :7.

Test	Mean ± SD	Z value	Significance (p value<0.05)
FES Pre Test	52.60 ± 8.854	-3.06	0.001
FES Post Test	32.93 ± 13.161		

Table no:7

Analysis for Berg balance scale Test between the groups

Mann-Whitney U test was used to compare the post- intervention score between the BBS group –A and group –B, results indicated that there was a statistically significant difference between two groups (Z= -2.263). and(p =0.023) as mention in table no : 8.

Groups	N	Mean rank	Z value	Sig (p value)
Group A (SIT)	15	16.50	-.624	0.53
Group B(DT)	15	14.50		

Table no: 8

Analysis for fall efficacy scale between the groups

Mann-Whitney U test was used to compare the post- intervention score of FES in group –A and group –B, results indicated that there was a no statistically significant difference between two groups (Z=-1.954). and(p =0.50) as mention in table no : 9

Groups	N	Mean rank	Z value	Sig (p value)
Group A (SIT)	15	18.20	-1.68	0.09
Group B(DT)	15	12.80		

Table no:9



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Discussion

The purpose of this study was to evaluate and compare the effects of two different therapeutic interventions i.e sensory integration training and dual task training on balance performance and fall efficacy. Balance performance and fear of falling among elders are common and can significantly affect their independence, mobility and overall quality of life.

The results of post data analysis of this study demonstrated that (Group – A) sensory integration training shows significant improvement in berg balance score scores, indicating that the intervention was effective in enhancing balance control among the elderly. The improvement in balance in post sensory integration training aligns with previous research by Thompson and savadkoochi (2020), demonstrated that sensory type balance training led to significant improvement in their balance and postural control. Following several weeks of training participants showed marked improvement in BESS score.(28). These findings support the current study’s result that showed significant improvement in balance in (group- A) sensory integration training group.

Similarly, Puranik et al ,(2012) the study has demonstrated the improvement in balance following sensory specific balance training in healthy elderly ,from the study it can be concluded that sensory specific balance training can bring about a significant improvement in balance without any change in the muscle strength(27). Suggesting that such interventions effectively counteract age related declines in sensory processing and motor control. Together these finding support the role of sensory- focused interventions in improving postural stability and reducing fall risk in elderly population , however in the current there was no significant change in fall efficacy scale .Since the fall efficacy scale is self-reporting rather than objective performance based measures. This can lead to discrepancies between perceived ability and actual performance, potentially impacting the validity of research findings (29).

In contrast group –B dual task training showed no significant improvement in berg balance scale this result aligns with the similar study done by Volkan et al.(2021). In this study the author concludes that , the impact of integrated dual task training and consecutive dual task training on balance and gait performance in older adults was not statistically significant , and this study suggested that consecutive dual task balance training can be used as an alternative method.(31).

Between the group analysis showed that participants in sensory integration training group demonstrated comparatively greater improvements than those in Dual task training group for between the group analysis we have used Mann–Whitney U. the berg balance scale mean rank is higher in group A as compare to Group B (DTT) This reflects that balance improved more in Group A. However, the difference was not statistically significant in between the groups analysis. This could be due to variation in participants responses, which reduced the strength of the results .For FES scores (fear of fall), group a had higher mean rank and group B had a lower mean rank . But the difference was not significant. So even though the scores improved, the change was not large enough to be considered significant. This indicates that SIT tended to be more effective for balance, but the results weren’t strong enough to confirm.

There were some factors that are responsible for this result for example nature of intervention in sensory integration training intervention includes sudden shift of surfaces for example standing on different foam, and it also includes visual activity such as eyes open and eyes closed. Repeated sensory training in our work ,introduced new stimuli to the somatosensory system and encourage the CNS to employ new strategies to maintain balance. In other words the adaptation ability of central nervous system to test condition and maintain balance (28).

Neuroplasticity , is the brain’s ability to adjust, sensory integration training, which includes exercises targeting visual, vestibular and somatosensory systems that are responsible for the balance and



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postural control , similar to the findings in Bhatt .et al,(2023)the narrative of this review explain that neuroplasticity and rehabilitation, by spotlighting neural adaptation.(42).

As this study showed that when the brain gets repeated sensory input , our brain adapt and learns to respond better way , so in our study seen in group A might be due these neuroplastic changes in the brain.

6.2 Clinical relevance

The study highlights that there was a statistically significant improvement in berg balance scale in sensory integration training group (group –A) , whereas the dual task training (group – B) showed significant improvement in participants fear of fall. Clinician can use can use this evidence to tailor intervention based on their goals.

6.3 Limitations of the Study

- The study included a limited number of participants, which may affect the generalizability of the findings to a larger population.
- The interventions were delivered in a controlled clinical environment, which may not fully replicate the real-life challenges older adults face in daily situations

6.4 Future recommendations

The findings also suggest that balance is a multifactorial construct, influenced by sensorimotor, cognitive, and psychological domains. Future studies should consider the combination of both the approaches or combining the approaches with other balance training intervention to improve balance and fall efficacy.

The study concludes that Sensory Integration Training (SIT) had statistical significant effect on balance performance, while Dual Task Training (DTT) contributed more in improving fear of fall . These findings underline the importance of selecting intervention strategies based on the individual needs.



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